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Conditions of Soviet Technology

Industrial Innovation in the Soviet Union. RONALD AMANN and JULIAN COOPER. Yale University Press, New Haven, 1982. xxx, 526 pp. $60.

This large volume is a culmination of nearly a decade of research by a team of economists, political scientists, and engineers at the University of Birmingham, England. Their task was to investigate the process of applied science and innovation in the Soviet Union through detailed case studies of individual branches of industry and of particular technologies. The results of the first phase of the investigation, focusing on the levels and pace of technological development in nine industries relative to that of the United States, Western Europe, and Japan, was published in 1977 (*The Technological Level of Soviet Industry*, edited by R. Amann, J. M. Cooper, and R. W. Davies). The conclusions of this essentially measurement phase of the investigation were that Soviet industry was technologically backward relative to Western market economies and that for most technologies no substantial reduction of the generally sizable gaps had occurred in the preceding 15 to 20 years, whether in the prototype stage, in commercial application, or in diffusion. Subsequent trends in Soviet industry in the late 1970's and early 1980's, additional research by Western scholars, and numerous statements by Soviet authors amply support those judgments and even suggest that the technological gap may be widening in some cases.

The second phase of the investigation, resulting in the volume under review, sought to explain the observed differences in relative backwardness, again through the prism of selected industries and technologies—machine tools, chemicals, industrial process control, and defense technologies, along with organizational innovations represented by group technology (a system for uniting disparate engineering components into families to more efficiently accomplish given production tasks) and automated (computerized) systems for accomplishing various kinds of management tasks. Also addressed in this volume are the highly relevant issues of Soviet ability to assimilate and diffuse imported Western technology and the nature and effectiveness of reforms of the research and development process carried out over the past dozen years. The results represent interdisciplinary research at its best.

As the authors of the studies agree, Soviet technological backwardness cannot be ascribed to failure to mount an appropriate R & D effort. Total R & D expenditures, at least half of them devoted to military purposes, amounted to 3 to 3.5 percent of total gross national product in the 1970's, considerably higher than in most Western countries, and the share has been rising. Moreover, the Soviet Union has focused its higher education on turning out engineers and scientists, so that in 1978, with a total GNP about half that of the United States, it had over 50 percent more specialists engaged in R & D work. Nor can the lag be laid to the failure of the Soviet leadership to recognize the problem. Indeed, recent speeches of Brezhnev and a mass of anecdotal reporting in the Soviet press provide plenty of evidence of both perception of the seriousness of the problem and an acute concern to find solutions. What requires explanation, rather, is why the returns from the vast R & D effort have been so meager overall (at least in the civilian sector) and so uneven among industries.

The systematic obstacles to innovation in Soviet industry are familiar to Western Sovietologists. They have been analyzed in depth in such major studies as the OECD's *Science Policy in the USSR* and Berliner's *The Innovation Decision in Soviet Industry*. One of the most serious obstacles is the rift between science and production. For the most part, R & D is carried out in government institutions having an academic orientation and few contacts with their customers—the producing enterprises. Thus, the users and potential beneficiaries of new technology play a minor role in its development. Because new projects are developed and designed by one set of agencies, the requisite facilities and equipment built by another set, and the new technologies actually used by a third set, bureaucratism, delay, red tape, mountains of documentation (paper work), and inertia are severe drags on the innovation process. Moreover, the incentive arrangements for R & D organizations and their personnel have tended perverse "success indicators" such as fulfilling research budgets, number of projects designed or completed, and self-estimated "economic effects" from introduction of the results into practice. With the pervasive absence of close scrutiny by customers, these incentives have resulted in proliferation of projects, low quality, and trivial changes in design masquerading as new technologies. Finally, at the producing level, incentives have been tied to meeting plans for quantities of output, measured variously, leading industrial managers to "shy away from innovation as the devil shies away from incense," to borrow Brezhnev's phraseology. These three obstacles would seem to be the major ones, but many others are imbedded in the working arrangements of centrally planned socialism as practiced in the U.S.S.R.

The case studies confirm in a most revealing way the prevalence of these systemic impediments to innovation, most prominently in the civilian sector, and document their pernicious effects on the innovation process. Even the vaunted defense sector is not entirely immune. But the case studies also yield important new insights into the innovative process by providing rich and often fascinating historical and institutional detail relating to the experience of particular branches and the origin and development of specific technologies. From such invaluable material it is evident that systemic factors alone cannot account for the sizable differences among sectors in relative technological backwardness; rather, the diversities are rooted in differences in initial relative levels of technology in 1917, in the particular modernization strategies pursued, including the extent of resort to importation and replication of Western technologies, and in disparities in the relative investment priority accorded to individual sectors. In some cases, also, an important role was played by the active intervention of top political leaders (Khrushchev's "chemicalization" drive of the early 1960's) or by the entrepreneurial role of talented scientists (illustrated by the development of group technology).

Not surprisingly, the authors find technological lags to be smallest in sectors, such as defense and space, that consistently have had highest priority claim on resource allocations and that have always been the focus of attention of the political leadership. Much indigenous innovation has, indeed, occurred in military technologies—primarily incremental in the case of tanks, for example, and fairly revolutionary in the case of

such sophis
ICBM's. The evidence assembled in the two long chapters on defense sug[illegible]s, however, that the institutional arrangements in the defense sector have much in common with those in the civilian sector—similarity in the R & D cycle, in organizations, and in incentives—and defense plants often also produce civilian products. Thus, spontaneous innovation in the defense sector tends to be hampered by factors that retard innovation in the civilian sector. Since defense is to be viewed "as an integral, if special, part of Soviet industry," its comparatively greater innovativeness can be ascribed largely to the presence of a single, demanding customer, the armed forces, to the sector's unwavering priority claim on scarce labor and high quality materials, but perhaps most of all to a competitive race with foreign states, which have presented Soviet military planners with a constantly moving target. Even so, the study concludes, Soviet military technology tends to suffer by comparison with that of the United States in quality and level of sophistication. To compensate, and because it eminently suits the system's modus operandi, the Soviets have stressed quantity goals—"vastness of deployable stocks."

Through the revealing perspectives of these case studies, both the strengths and the weaknesses of socialist central planning as an engine for promoting technological progress are clearly portrayed. Two fundamental conclusions seem unassailable. First, contrary to the assertions of many socialists, the system of socialist central planning as a replacement for a private-enterprise, market-oriented system has proved to contain serious systemic fetters, both on indigenous technological dynamism and on the ability efficiently to absorb and diffuse technologies imported from abroad. Second, an industrial development strategy based on an all-out concentration of resources on key objectives and sectors leaves serious, perhaps fatal, legacies as neglected sectors and objectives become constraints in an increasingly complex and interdependent industrial structure.

In the past 15 years the Soviet government has launched numerous economic "reforms" and reforms of these reforms, in an effort, among other objectives, to remove some of the systemic obstacles to innovation. These changes, many of them described in the study's concluding chapter, aptly entitled "Innovation for innovation in Soviet industry," have included: setting up "science-production" associations to eliminate the rift between R & D and production; new incentive arrangements for R & D scientists and engineers geared to the utility of their work to customers; the extension to the civilian sector of program-goals planning and management, an approach long used in the defense sector; revised success indicators for producing enterprises intended to mitigate their risk aversion; a product-quality certification scheme intended to eliminate the common phenomenon of pseudoinnovations in product design; and many, many others. The reviewer readily endorses the author's conclusion that these many innovations have not resulted in any fundamental change and that much "bolder leaps" will be needed if technical lags are to be overcome, but would add that these "leaps" must alter the economic system itself, something that none of the reforms has even approached up to now.

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Prices of Books

Average per-volume prices of books reviewed in *Science* 1978–1982. Data are for hard-cover books except where books were available only in paperback; books priced only in foreign currencies were excluded from the calculations. The average prices per page of the technical books in the natural sciences for the years covered were 7.8¢, 8.6¢, 9.0¢, 11.3¢, and 11.1¢.

Category	Price (dollars)				
	1978	1979	1980	1981	1982
All books	29.65	30.33	35.52	42.22	44.05
Technical books in the natural sciences	36.04	39.18	42.61	52.76	51.70

Urban Environmental Efforts

The Healthiest City. Milwaukee and the Politics of Health Reform. JUDITH WALZER LEAVITT. Princeton University Press, Princeton, N.J., 1982. xviii, 296 pp., illus. $22.50.

Garbage in the Cities. Refuse, Reform, and the Environment, 1880–1980. MARTIN V. MELOSI. Texas A&M University Press, College Station, 1982. xvi, 268 pp. + plates. $21.50.

During the late 19th century, American society was transformed by urbanization and industrialization. In the years 1850 to 1900, Milwaukee's population increased from 20,000 to nearly 300,000 as what had once been a pleasant wheat-trading center became a congested factory city. The urban population explosion posed grave health problems. The poor were herded into small, squalid houses without running water or indoor toilets. Factories belched their noxious wastes into the air and slaughterhouses threw animal carcasses onto the streets. Milk was obtained from emaciated and diseased cows housed in manure-littered barns. Inadequate housing and unsanitary conditions provided a nursery for communicable diseases. Tuberculosis, pneumonia, and infectious diseases of childhood were endemic and caused the most deaths. However, it was the unexpected epidemics of smallpox and influenza that caused the greatest fright.

To meet the challenges presented by the rapid, unplanned growth experienced by Milwaukee and other American cities municipal health departments were established and were entrusted with responsibility for control of infectious diseases, sanitation, and regulation of the food supply. Leavitt provides case studies of each of these concerns to illustrate the work of the Milwaukee Health Department. The three subjects she has chosen for intensive examination—smallpox, garbage, and milk—illuminate her special concern with the politics of health reform.

Leavitt's analysis demonstrates that improvements in public health depended as much on the support of politicians and community leaders as they did on advances in medical knowledge. At first public health officials were insensitive to the politician's need to dispense patronage and the immigrant's fear of government intrusion in family and neighborhood matters. It was not until they learned to educate the urban poor about the need for vaccination, disinfection, isolation of the sick, and other such matters that they began to gain their objectives. In time health officials learned to work with community activists and political leaders in establishing neighborhood health centers and health education programs.